

**E-Commerce and the Changing Terms of Competition in the Trucking Industry: A Study
Of Firm Level Responses To Changing Industry Structure**

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E-Commerce and the Changing Terms of Competition in the Trucking Industry: A Study Of Firm Level Activity

Abstract

The integration of the internet into business activities is affecting the trucking industry both directly and indirectly. Direct influences involve changes in information brokerage in the highly fragmented trucking industry. Indirect influences arise as shippers and consignees, which are the customers of trucking firms, invoke demands for lower shipment prices, greater service quality, quicker delivery, critical service innovation, and greater logistics support. The internet has brought new firms into the trucking sector, which are using the information aggregation capabilities of the internet to create new business opportunities in a fragmented and geographically dispersed industry. At the same time, many incumbent firms in the trucking industry have responded to the internet environment both by attempting to become more efficient and by beginning to transform themselves to become vehicles of e-commerce. In this transformation, trucking industry incumbents are increasing the variety and customization of freight movement services that they offer their customers and are integrating their transportation and logistics services so as to provide one-stop shopping solutions. Traditional trucking firms are also exploring new opportunities in related transportation industries such as home delivery and package express. Rather than simply being “trucking companies” that transport goods between two points, the major players in the industry are becoming “asset-based transportation management” service providers that oversee a broad set of transportation services, many of which emphasize managing information rather than handling physical goods. In the dual process of attempting to become more efficient while also undertaking major business changes, the firms are seeking to both exploit existing skills and explore new opportunities that require new skills and organization. Evidence from a survey of trucking firms suggests that most firms are investing in internet technology for both exploitation and exploration objectives and, in the process, are re-organizing and restructuring in order to respond to the opportunities and challenges of the new economy.

E-Commerce and the Changing Terms of Competition in the Trucking Industry: A Study Of Firm Level Activity

Electronic commerce is changing the competitive landscape of the trucking industry. We define e-commerce to include business processes that permit transactions and trade to take place on the web, as well as processes that use the internet as a repository, an enabler, and a conduit of information (Sampler, 1998; Rayport and Sviokla, 1995). Trucking firms are using the internet's strategic building blocks of distributed access to valuable information, quick communication, and boundary-defying connectivity to exploit current resources and capabilities and to explore new internet-enabled business opportunities.

This paper proceeds as follows. Section A discusses the background of the trucking industry, concluding that the industry is highly competitive and volatile. Section B uses several examples to depict the impact of e-commerce on the industry, concluding that information availability stemming from the internet is creating demands to exploit existing skills in order to increase efficiency as well as opportunities for exploration of new transportation services. Section C discusses emerging changes in industry structure, again providing examples, concluding that alliances and acquisition activity will take place on horizontal and vertical dimensions, as firms seek greater scale and coordination for both operating efficiency and service innovation. Many of these changes in industry structure stem from firms' attempts to gain access to new resources and to coordinate the use of heterogeneous capabilities. Section D reports a survey of firm level internet activities within the industry, concluding that the internet is just beginning to become an important source of trucking activity, with intriguing impact on services, organization, and performance. Section E concludes the paper.

A. Trucking Industry Background

Freight transportation, particularly by truck, is central to the health of the U.S. economy. Over 11 billion tons of freight were transported in the United States in 1997. These shipments generated over \$457 billion in revenue for the domestic transportation industry. Of these shipments, trucks provided for 60% in shipment volume and 81% in shipment revenue, making the trucking industry the dominant mode for freight movement (Figures 1 and 2).

******* Figure 1 and Figure 2 about here *******

The trucking industry has gone through a long cycle of regulation and deregulation, leading to high industry volatility. Following the Motor Carrier Act of 1935, for-hire companies that wanted to haul freight across state lines had to obtain authority from the Interstate Commerce Commission. Most carriers set prices for their services through a collective rate-making process made legal by federal antitrust exemption. The federal Motor Carrier Act of 1980, although it did eliminate state-based regulation of trucking companies, initiated substantial changes at the interstate level by allowing easier entry, providing greater pricing flexibility, eliminating restrictions on how many customers a contract carrier could serve, and reducing restrictions on private fleets. Following 1980, increased industry capacity quickly resulted from the rapid expansion by entrants and incumbents. During the late 1990s, over 3,000 carriers a year were gaining new or additional operating authority. Competition has led to lower rates and typical operating ratios average in the mid to high ninety percent range, up from about 95% in 1980 (the "operating

ratio", which is the percent of operating revenues required to pay operating expenses, is a key efficiency measure in the industry). About 48,000 carriers went out of business from 1980 to 1999, following deregulation, including 74 of the top 100 firms from 1984.

The trucking industry is both highly segmented and extremely fragmented. Within the trucking industry, freight movement is distributed among truckload (TL), less than truckload (LTL), and private fleet segments. A reasonable approximation of the number of U.S. trucking firms, combining information from several sources, is that there were almost 500,000 inter-state motor-carriers in the U.S. in 1998; this number includes about 30,000 for-hire carriers, while the remainder were private fleets. Of the 30,000 for-hire carriers, about 21,000 (69%) were TL specialists, about 8,000 (28%) handled both LTL and TL shipments, and 1,000 (3%) were LTL specialists. Most firms are quite small. Over 70% of the inter-state carriers operated six or fewer trucks, while 79% had 20 or fewer trucks. Nearly two-thirds of the 30,000 for-hire carriers had annual revenues of less than \$1 million.¹

Truckload (TL) carriers specialize in hauling large shipments for long distances. Most TL shipments are over 10,000 pounds, with the average TL shipment weighing about 27,000 pounds. The national truckload market is further segmented into national dry van, regional dry van, refrigerated/temperature controlled, flatbed, tank truck, and specialized operators. In the TL segment, an owner-operator² or a driver employed by a TL firm will pick up a load from a shipper and carry the load directly to the consignee, without transferring the freight from one trailer to another. Thus, TL carriers do not need a network of terminals. The TL segment of the industry consists of highly competitive operations, which typically are non-union facilities, that use owner-operators to minimize fixed costs and focus on achieving high vehicle productivity. Figures 3 and 4 show that the TL segment moves 45% of primary shipment volume, while accounting for only 37% of shipment revenue. TL firms concentrate on high density corridors and balanced freight flows, in order to ensure high vehicle use and low costs.

******* Figure 3 and Figure 4 about here *******

Less than truckload (LTL) carriers haul shipments that tend to weigh between 150 and 10,000 pounds. The average LTL shipment weighs slightly over 1,000 pounds. Key economies of scale and density for an LTL carrier come from consolidating many shipments that are going to the same area. Such consolidation requires a network of freight terminals. Therefore, LTL carriers are characterized by networks of consolidation centers and satellite terminals. The average length of haul for national LTL firms is about 650 miles and the average for regional LTL firms is about 250 miles. Thus, a pickup-and-delivery truck typically will transport an LTL shipment from the shipper's dock to the trucking firm's local terminal, where dock workers will unload and recombine the shipment with other shipments that are going to similar destinations, most often a

1. Sources that we used for the information in this section include American Trucking Association (1999), Newport Communications (1999), and Standard & Poor's (1999). Estimates of numbers of U.S. trucking firms vary substantially, because of the size and fragmentation of the industry.

2. An owner-operator is a sole proprietorship or other small company whose primary purpose is to operate one or more trucks for hire.

destination terminal in another city. The process of moving groups of shipments from one city terminal to a terminal at another destination is known as line-haul operations, which may be accomplished by large trucks or by another transportation mode (e.g., rail or ship), depending on price and service considerations. Once the shipment arrives at its destination terminal, the load is processed, moved to a pickup-and-delivery truck, and then hauled to the consignee. LTL shipments accounted for 3% of U.S. shipment volume and 16% of revenue in 1997 (Figures 3 and 4).³

Despite competition and over-capacity in the for-hire segments, private fleets operated by manufacturers or distributors still account for about half of U.S. volume (52% in 1997) and revenue (47% in 1997) of general freight shipments (Figures 3 and 4). Private fleets focus on medium to short hauls, while outsourcing the lengthier hauls to the for-hire market. The private trucking market share grew following deregulation, but has been declining recently due, in part, to the availability of low price alternatives and, in addition, to the complexity of the logistics process involving increased imports and exports.

In summary, several features of the trucking industry are notable. The industry is critically important to the economy, is highly competitive, faces high demands for efficiency, has frequent entry and exit, and consists of many small carriers with a few larger firms. This is the industry setting in which the opportunities and challenges of e-commerce arise.

B. The Impact of e-Commerce on the Trucking Industry

The internet has had both direct and indirect influences on the trucking industry. The direct impact centers on information brokers, which traditionally have managed the flow of shipment information in the fragmented trucking industry. The indirect impact of the internet arises because e-commerce is changing the competitive landscape in which the customers of trucking firms must operate.

The key reason that the internet is affecting the industry stems from greater detail about goods and services, prices, and timing. The changes in information result in both potential for greater efficiency in traditional transportation activities and in the creation of demand for new types of transportation activities. The immediate impacts of increased dissemination of information include greater price pressure and greater incentives for efficiency. In addition to greater efficiency of traditional services, though, increased information is also leading to more fine-

³ In the past few years, largely as a result of the emergence of the internet economy that we talk about in this paper, package express (PX) companies such as UPS have become a highly visible part of the LTL segment (indeed, many of the larger package express firms have merged with “traditional” LTL companies). There are several key differences between PX and the rest of LTL, including (1) the equipment needed to move goods; PX has more items to deliver but the goods are lighter and PX pick-up-and-delivery vehicle (PUD) drivers do not need to operate fork lifts; and (2) the volume of material to pick up and deliver; PX usually has 10 to 15 pick ups or deliveries an hour while LTL has about 2 to 5 per hour. PX and the rest of LTL share key similarities, though, in aggregating shipments from multiple sources and then disaggregating them to multiple consignees.

grained market segmentation, as well as to demands for new goods and services by trucking companies.

With the dual demands for greater efficiency and innovative services, the internet is causing substantial pressure on the capabilities of trucking companies. Firms are able to respond to some demands through incremental expansion of their existing expertise (Richardson, 1972; Langlois and Robertson, 1995). Many changes, though, require major changes in routines and resources (Karim and Mitchell, 2000). In some cases, the new skills will destroy firms' existing competencies (Tushman and Anderson, 1986), as in the case of freight brokers that we will discuss below in this section, so that the firms face strong internal resistance to change. In other cases, the new skills require routines that the firms can not create from their existing repertoires of routines (Nelson and Winter, 1982), as in the case of integrated logistics services that we will discuss in the next section of the paper. In either case, whether due to internal resistance or lack of existing routines, many changes will be far beyond the ability of the firms to develop internally within the available time and cost constraints. As a result, acquisition and alliance activity is becoming increasingly common in the industry, with the inter-firm activities arising from the need to gain access to new resources and coordinate the use of heterogeneous resources (Capron, Mitchell, and Oxley, 1999). Thus, through combinations of internal development, alliances, and acquisitions, firms are attempting to exploit their existing skills while also exploring new business opportunities (March, 1991).

B1. Changes driven by the availability of shipment information for freight brokerage

The key direct impact that increased electronic information is having on the trucking industry involves load-matching and volume discounts. The strongest challenges are arising for freight brokers, which traditionally have provided these services to trucking companies and their customers.

In the trucking industry, productivity gains, given legal restrictions on size and weight, come mainly from two sources: (1) fewer empty miles and/or higher cubic space utilization,⁴ and (2) less waiting time at the dock. The trucking industry is fragmented and geographically dispersed, as we noted in the prior section, so that coordination of disparate fleets and drivers is critically important. Load-matching services provide information that matches available shipments with trucks that have available cargo space, in order to increase trailer utilization and decrease waiting times. Load matching information is valuable to small firms and owner-operators, as well as to large firms that are interested in increasing productivity by reducing empty back-hauls.

Load matching traditionally has been the business of freight brokers (freight forwarders), which act as transportation intermediaries to manage the co-ordination of information and freight. New types of electronic brokers such as Transplace.com and freightquote.com, which we discuss below, are threatening the future of traditional information brokers, both from within the industry and through entry to the industry. Some trucking industry incumbents are exploiting their

4. Space utilization is particularly important for LTL shipments, particularly for LTL companies providing national service, but also applies to TL carriers. The benefits from reducing empty miles arise in both segments.

existing capabilities and physical assets to extend into the information brokerage segment of the industry, as exemplified by Transplace.com, while freightquote.com is an example of an industry entrant that is using the internet to integrate information and conduct e-commerce.

Transplace.com is an example of how industry incumbents are combining asset rationalization and the management of information to gain efficiencies. The objective of Transplace.com is to create a high volume freight network that will increase equipment utilization for fleets and reduce waiting time for drivers. Transplace.com serves as an information aggregator in the fragmented truckload sector, with its tens of thousands of competitors, by helping both shippers and carriers to match loads and rationalize capacity.

Six of the largest publicly held TL carriers agreed to combine their logistics operations into the new Internet-based transportation logistics marketplace, calling it Transplace.com. The six firms that combined their expertise in regional and national truckload freight movement include Covenant Transport, J.B. Hunt Transport Services, M.S. Carriers, Swift Transportation, US Xpress and Werner Enterprises. In addition to providing logistics services, Transplace.com will negotiate discounts for fuel, equipment, maintenance and parts, insurance, credit, and other services for its equity partners and other carriers that choose to join the purchasing co-operative. The founding firms hope to leverage their bricks and mortar experience, their physical assets, their industry-specific information technology expertise, their brand equity, and their customer relations in the electronic marketplace. Such moves in the trucking industry parallel attempts to create market-specific mega-marketplaces such as those that are being established by auto industry giants such as GM, Ford, Toyota, and Daimler Chrysler, consumer products firms such as Procter & Gamble, Nestle, and H.J. Heinz, and retail stores such as Kmart, Target, Tesco, and Safeway.

While Transplace.com leverages its traditional transportation asset base in the e-business environment, a new genre of information brokers is emerging on the internet. Table 1 lists some of the exchanges spawned by the internet. These exchanges arise owing to the geographic dispersion of the industry and the small size of most carriers. The new exchanges challenge traditional freight brokers in managing the co-ordination of information and freight. At the annual convention of the Transportation Intermediaries Association in March 2000, the dominant topic of discussion was the threat posed by the internet and new load matching software.

***** **Table 1 about here** *****

Freight brokers note that the internet is challenging them in two ways. First, in shipper-driven brokerage substitution, the internet enables many shippers to post loads and solicit competitive bids directly from carriers, which use the internet to identify backhauls. This process combines load-matching with competitive pricing. In the process, the shipper receives the advantage of a low bid and the shipper increases productivity by reducing empty miles. In this scenario, however, the traditional freight broker has no role. Instead, shippers function as their own brokers, dealing directly with freight companies.

Second, the internet allows new intermediaries to aggregate loads and obtain volume discounts. Freightquote.com is an example of an internet-based info-mediary that specializes in the trucking

industry. Freightquote.com targets smaller shippers that do not have enough volume to negotiate discounts on their shipments. Freightquote.com leverages the volume generated from smaller shipments to gain discounted rates. On its internet site, shippers can identify prices and order deliveries. Membership is free for shippers, although membership information provides freightquote.com with valuable shipper and carrier data. Shippers pay a fee each time they use the service to ship a load of goods. Freightquote.com handles arrangements for pick-up, paperwork, and billing online. This scenario provides a critical role for freight brokers in the changing industry, unlike the emergence of shipper-driven brokerage substitution, but requires brokers with new information technology skills and management abilities.

In order to take advantage of the information-based brokerage opportunities, both brokers and trucking firms require new skills. Key capabilities include information technology skills, including capability to use many types of hardware and to develop and deploy many types of software, and organizational skills, especially the ability to integrate information technology personnel and systems with other elements of the businesses. Brokers must be able to provide new information through new media. In parallel, trucking companies must develop skills that allow them to identify and negotiate shipments that are now available because of the increased information. The new information-based brokerage environment allows some incumbents to use inherent strengths and capabilities to exploit new opportunities and opens the door for new entrants with skills appropriate for the new competitive landscape to explore new business models.

B2. Changes driven by changes in the competitive environments of shippers and consignees

In addition to changing the competitive environment of freight brokerage in the trucking industry, shippers and consignees are placing new demands on trucking companies as they face changes in their own competitive environments. In general, these new customer demands are arising in all customer industries as the increased availability of information has reduced distance constraints in terms of market reach and is transforming processes for the creation of goods and services. More specifically, the emergence of electronic commerce in many consumer and production markets has created new shipment requirements for customers of the trucking industry. In part, trucking companies can respond to new opportunities and demands by building on their existing capabilities. In addition, though, transportation companies will need substantial sets of new skills in order to respond effectively to many of the opportunities.

The impact of changes in customers' competitive environments on trucking companies has been two-fold. First, shippers and consignees, which are the customers of trucking firms, are demanding refinements of existing trucking services. For instance, manufacturing firms are adopting practices such as just-in-time delivery and/or production and electronic data interchange (EDI), which in turn require the timely movement of raw materials to the production location and to appropriate distribution areas as finished goods. Similarly, wholesale and retail distributors are increasingly demanding more frequent delivery of goods and services, often supported by extensive EDI. Trucking firms have had to alter existing practices to ship goods more quickly, cheaply, and with increased service quality. Second, as an integral part of the supply chain, trucking firms are exploring new information-enabled opportunities to expand the existing suite of services and explore opportunities to create new transportation services. Both

types of changes require that trucking firms undertake a combination of exploitation and exploration, as they improve their use of existing skills and acquire new capabilities far afield from their existing skills.

Arnold Industries and UPS serve to illustrate cases in which trucking companies are redefining the boundaries of the services they offer in the internet-enabled economy. Arnold Industries has long been a profitable LTL company. Over the past decade, the company has expanded into the regional TL segment by acquiring TL firms. The company is now combining its trucking and warehouse operations to offer one-stop order fulfillment services for e-tailers and mail-order catalog companies. These services include order processing, inventory management, and small package shipping. In this process, the company has transformed its business to improve its ability to fill orders quickly and precisely. The firm has turned its warehouses into logistics hubs where more than 600 people are involved in the order fulfillment process: receiving goods from manufacturers or suppliers, processing, packaging, and delivering to customers. Arnold Logistics also provides value-added services by comparing freight rates and handling customer returns. Further, Arnold Logistics takes online orders on behalf of its shippers and also provides live-chat and e-mail support for customers. The traditional LTL and TL segments of Arnold Industries have gained some benefits from the new business activities, because shipments to the logistics warehouses use TL and LTL services. In addition, and at least as importantly, the company has gained substantial expansion into new transportation services that emphasize information management rather than physical handling of goods. Thus, Arnold industries have transformed their definition of the transportation business to extend far beyond movement of freight. They have leveraged their knowledge and expertise to become “an information transfer point” in the new economy (Bearth, 2000a).

Several examples involving UPS further illustrate how trucking companies are integrating themselves into the web of internet activities. UPS dominates shipping from internet retailers. For instance, UPS delivered 55% of the goods ordered online in the 1998 Christmas season. UPS's relationship with Nike demonstrates the basis of UPS's success. In order to expedite the order-to-delivery process for Nike.com, UPS stocks Nike shoes and warm-ups in its Louisville warehouse and fulfils customer orders hourly. Indeed, UPS plays a direct role in the order process, as well as in delivery, because a UPS call center in San Antonio handles Nike.com customer orders. Consequently, Nike saves on overhead costs and, most importantly, achieves quick sales turnaround.

Another UPS example is the company's relationship with the fashion web site Boo.com. UPS handles batches of supplier shipments, inspects the merchandise, and packs it in Boo.com branded boxes for shipment (Barron, 2000). Thus, UPS is an integral part of Boo.com's business.

An initiative with the Ford Motor Company provides a third UPS example. In early 2000, UPS and Ford announced an alliance in which UPS will oversee the delivery networks for Ford vehicles. A key element of the system that UPS will establish for Ford is a vehicle tracking system that will allow Ford to track the location of each vehicle from production through delivery. Eventually, customers may be able to use the system to track the vehicle that they have ordered. As the internet becomes an integral part of the interface between the automotive firm and its customers, car buyers are making decisions based on extensive internet research and car

companies are using information to differentiate themselves. The alliance with UPS is an attempt by Ford to move from a mass distribution system to a virtual delivery plan for each vehicle. UPS will use its technological expertise and logistics capabilities to help create this transition. The two firms' goal for the new delivery system is to reduce delivery times by about 40%, while increasing reliability and reducing costs.

In each of these examples, similar to the Arnold Industries example, UPS is extending its activities far beyond traditional movement of goods. Rather than simply being a “package express” shipper, the company is undertaking many business processes, ranging from receiving customer orders, warehousing goods, and coordinating after-sales services.

Such business transformations mark both changes in the services that companies such as Arnold Industries and UPS offer and a redefinition of trucking industry boundaries. Until recently, most analysts omitted companies such as logistics providers and package express carriers from the trucking industry. As the boundaries between transportation services become increasingly blurred, though, firms that provide these services clearly are now central to the industry.

At the same time, though, the nature and even the name of the industry has changed substantially. Rather than simply being “trucking” companies, many of the firms in the industry have become “asset-based transportation management” service providers. This new term means that the companies own and operate physical assets, including new types of assets such as warehouses and information systems as well as to their traditional investment in trucks. In addition, the companies provide a broad range of information-based transportation management services that emphasize coordinating many steps in the production-to-customer value chain. These additional services range from warehousing goods, to order taking, to logistics management, to after-sales services.

In summary, the internet is changing the competitive environment of the trucking industry, both directly in challenges to traditional freight brokers and through changes in trucking company customers' competitive environments that are challenging trucking firms to transform their business services. In this process, the borders of the trucking industry and other transportation-oriented sectors such as package express are becoming increasingly blurred. In addition, traditional trucking companies face incentives to transform their businesses from primarily emphasizing shipment of goods, to providing a broader set of “asset-based transportation management” services.

Responses to these demands are arising from both new entrants to the industry and from industry incumbents. New entrants are emphasizing relatively fine-grained services such as internet-based information brokerage. By contrast, industry incumbents are taking the lead in the development of the more complicated set of asset-based transportation management services. These early observations of industry dynamics are consistent with arguments by authors such as Penrose (1959), Singh and Mitchell (1993), and Christensen and Rosenbloom (1995) that incumbents often lead the industry in developing and adopting new technologies as long as the technologies address customer needs within the value network in which they competed. As industry incumbents expand their services, enter new markets and create new services, their

diversification choices reflect the relative applicability of their resources in the new technological environment (Silverman, 1999).

C. Change In Industry Structure: Industry Consolidation And Virtual Trucking

There is little doubt that the trucking industry will continue to be the dominant mode of freight transportation in the U.S. for the foreseeable future. At the same time, though, there will be major changes in industry structure. For instance, Standard & Poor's (1999) predicts that the share of primary freight shipments carried by for-hire operations will increase, substituting for private fleet, and that small package shipment handled by motor carriers will increase drastically, possibly in substitution of LTL carriers. These changes arise from changes in the internet information environment.

In the e-commerce environment, customers tend to view transportation as a continuous value proposition with no regard to segments or length of haul. This view has led to at least three types of changes that are affecting industry structure. First, as we began to outline in our discussion of freight brokerage above, some firms are exploiting the connectivity and access to information that the internet allows by offering "virtual trucking" services, in which the transportation companies serve as system integrators (Sampler, 1998). Second, faced with stringent demands for shipment time and quality, shippers would like to deal with one company for most or all of their inbound and outbound shipping needs. As we noted above, many incumbents in the trucking industry are restructuring to offer integrated transportation solutions by including logistics and other transportation options in their corporate portfolio of asset-based transportation management services. These firms are now offering suites of "one call, one carrier" services including TL, LTL, logistics, package express, and inter-modal services. Third, some incumbents are leveraging existing freight movement skills to explore new opportunities in related industries. These changes are leading to substantial changes in industry structure, though concurrent waves of consolidation, expansion, and entry.

C1. Virtual trucking: A new organizational form

The internet has given rise to a new breed of firm, "the virtual trucking company". Such companies own no assets themselves but, instead, act as system integrators for asset-based companies. For example, freightPro.com is an internet venture started by a group of trucking executives backed by \$3 million in venture capital. FreightPro.com uses the internet to compete directly with asset-based transportation management service providers. The new firm contracts with independent carriers, warehouses, and drivers to provide LTL freight transportation, while using web technology for services that range from rating shipments and scheduling pick ups to tracking shipments and billing customers. The founders are veterans of the trucking industry and have extensive knowledge about the inefficiencies in the LTL environment, so that the new venture is attempting to exploit the inefficiency of the traditional LTL business model. These inefficiencies arise because most LTL freight consolidation takes place in the very early hours of the morning, leaving the terminal facilities nearly empty the rest of the time. In contrast, LTL warehouses operators were busy only during the day. FreightPro.com proposes to execute an efficient virtual trucking business by using existing public warehousing space to consolidate shipments, using the internet and load planning software to put together pick up and delivery and linehaul routes, and subcontracting the shipments and routes on a per shipment basis.

The connectivity offered by the internet allows virtual truckers to communicate with shippers and subcontractors. In turn, the business proposition permits the firm to use embedded knowledge and current industry characteristics to advantage. Non-asset based logistics providers have been a part of the trucking environment for the past two decades since the widespread availability of computing hardware and software. However, limitations on immediate and widespread communication prevented these firms from expanding beyond very limited services. The internet provides the foundation for innovative integration of complex logistics algorithms with aggregation of fragmented information provide a seamless transportation alternative (Bearth, 2000b).

Virtual trucking is an example of the growing incidence alliances in the trucking industry. Like acquisition activity, such alliance activity also stems from needs for access to capabilities and coordination of activities (Nagarajan and Mitchell, 1998). At the same time, it is likely in many cases that the needs for coordination will involve sufficiently complicated interactions among the firms that the alliances will provide only partial solutions (Capron, Mitchell, Oxley, 1999). Instead, we believe it is likely that there will be increased reliance on business acquisitions in order to undertake the substantial changes that internet-based business will require.

C2. Industry consolidation and one-stop transportation solutions

Several trucking firms have developed portfolios of asset-based transportation management services through mergers and acquisitions. Examples include CNF Transportation, Caliber Systems, USFreightways, and CRST International. The operating units of CNF Transportation include a package express firm (Emery Worldwide), an LTL firm (Con-Way Transportation Services), and a logistics provider (Menlo Logistics). Similarly, the operating portfolio of Caliber Systems includes a package express firm (RPS), an LTL firm (Viking Freight), and a logistics provider (Caliber Logistics). Caliber, in turn, was acquired in late 1997 by Federal Express. Recently, USFreightways acquired Transport Corp. of America making it one of the nation's truckload carriers. USFreightways has expanded its primary business of providing regional LTL by acquiring a domestic and international freight forwarder, a reverse logistics firm, and a regional truckload carrier.

Notably, such acquisitions require substantial post-acquisition change and integration of the businesses. For instance, UPS is now undertaking greater vertical integration of its activities, in order to provide better coordination of the types of services that we described earlier. Similarly, CRST International has recently restructured itself into a single transportation services company by combining its six units into one operating unit. In the past, each unit served customers separately in their niche markets. Through the restructuring, CRST International combines CRST for TL, Malone Freight lines and the Three 1 truck line for flat bed services, CRST Logistics for logistics services, and an express LTL service. According to company President John Smith, "It didn't take a genius to figure out it was better approaching this as one team of professionals totally focused on the customer and making transportation as easy as possible as our customers" (Truck World, 1997).

Competitively, these organizations have to contend with the challenges posed in each of the segments in which the firms participate. Many of the firms began restructuring and consolidation

when logistics software became widely available and increasing cross-border shipments necessitated shippers to require multiple services from their trucking vendors (Nagarajan, Bander, and White, 1999). As more firms present themselves as providing transportation management services, the formidable task that lies ahead of them is to achieve the close coordination that is required to capture the benefits of being a single entity.

Many or most of the acquisitions in the industry involve vertical combinations of firms. Vertical combinations involve mergers of transportation providers and firms that provide complementary services, such as logistics firms and freight forwarders, rather than horizontal combinations of direct competitors. The rationale for the complementary vertical combinations involves, first, gaining access to capabilities that the firms require to refine existing services and offer new services and, second, providing greater coordination of changing activities than the firms could achieve through arm's length negotiation between independent companies (Capron and Mitchell, 1998).

C3. Exploring new frontiers

It has become an accepted part of reality that the internet is leading to major changes in retailing. The advent of pure play e-tailers such as Amazon.com and bricks-and-clicks combinations such as Gateway have introduced customers to new combinations of services in shopping. With a few clicks, and a bit (or a lot) of patience, customers increasingly can purchase goods and services almost anywhere, almost anytime. The e-commerce market presents an opportunity for the trucking industry. However, in order to exploit the growing potential of this environment, trucking firms have had to change their business practices in significant ways. These changes parallel our earlier discussion of asset-based transportation management.

Bekins Van Lines, a subsidiary of third party logistics provider GeoLogistics, created a new firm called Home Direct to focus exclusively on services for online retailing of home furnishings. The company combines the trucks of Bekins Van Lines and the trucks of 500 other LTL firms to deliver furniture from manufacturing sites to local markets. To further customize its support for online retailers, Home Direct offers a "white glove" service option in which the driver and a helper carry the furniture inside the home, place it in the desired location, and dispose of packaging debris. The extra service costs the customer about \$215, which is 72% above normal shipping rates and adds significantly to the firm's profitability. According to Jim Greiger, vice president of strategic marketing and development for HomeDirect USA, "It is no longer just logistics, trucking, and warehouse. Customer service is now a core focus". In this model, the trucking firm, as the only live contact between the retailer and the customer, now takes the role of the retailer's company service representative.

Other trucking firms have chosen to expand beyond their traditional segments to exploit the geographic reach of the internet. For example, Consolidated Freightways hopes to boost its customer base by moving beyond its traditional LTL services. The company has created a website CFMovesyou.com to provide household moving services. While moving household goods is significantly different from moving bulk freight and other LTL shipments, the internet has provided an opportunity for Consolidated Freightways to leverage its nationwide assets and use its expertise in logistics and freight handling to diversify into a new business opportunity.

Interestingly, since the traditional customers of Consolidated Freightways are businesses and CFMmovesyou.com is courting consumers, the CFMmovesyou.com maintains its distinct identity, with no link to the Consolidated Freightways website. Instead, the copyright information contains the only reference to the parent company.

The cases described above are instances where firms in the trucking industry are value innovators (Kim and Mauborgne, 1999). These firms are addressing the opportunities provided by the transformation of the traditional trucking industry structure. Their actions address the exogenously-created demands that arise from their shippers and consignees due the impact of technological change. In addition, trucking firms are also leading to further changes in their competitive and customer environments, by developing new demand for new products and services.

D. Firm-level activities: Information from a survey of the trucking industry

E-commerce is changing the nature and structure of the trucking industry. Consistent with these actions, firms have acted to transform their internal information-based operations. First, firms are attempting to align their structure, systems, and people with the new competitive environment. Second, firms have changed and improved internal processes by adopting information technology that emphasizes mobility and connectivity.

The data that we discuss in this section are based on reviews of trucking company web sites, plus data that we drew from a mail survey concerning the use and impact of information technology in the trucking industry.⁵ We summarize results from 177 respondents to the survey, which provide information concerning trends in the industry. The information from the survey applies to late 1999 and early 2000.

The respondents represent a cross section of the trucking industry. Segments represented include TL (40%), LTL (71%), logistics services (20%), package express (9%), and private fleet (30%) operators. About 55% of the firms participate in two or more of these segments of the industry. There is also a useful size distribution of respondents, with about 65% of the operating 100 or fewer power units and 35% operating more than 100 units.

D1. Organizational change: Structure, systems, and people

There is evidence that some trucking firms are pursuing innovative strategies to exploit the opportunities that e-commerce creates. Trucking firms increasingly are adopting the internet to accomplish their own e-commerce initiatives and have transformed the business organizations to accomplish their strategic objectives.

Trucking firms are using the web for automating many of their exchanges with shippers and consignees, improving communications, acquiring new customers, and customizing services. Table 2, which we developed by reviewing the internet sites of thirteen leading LTL carriers,

5. We conducted the survey during early 2000, with the sponsorship of the University of Michigan Trucking Industry Program (UMTIP). UMTIP receives generous support from the Sloan Foundation and from trucking industry corporations.

provides a list of the ways in which firms use the web and an indication of the extent of use of these features by some prominent trucking firms. It is evident that the internet offers the opportunity for trucking firms to improve processes, reduce paperwork, and reduce administrative overhead costs. At the same time, though, it is not yet clear whether the savings will be enough to offset the investment in new web-based technology and organizational change.

***** **Table 2 about here** *****

Our initial analysis of the survey responses provides useful information concerning several issues in the trucking industry. The summary addresses five areas, concerning the competitive environment, use of the internet, source of internet technology, organizational changes, and early impact of internet activities.

First, the firms report that the competitive environment has changed significantly since 1996, particularly in terms of time demands from customers. More than a third of the firms (37%) reported that they had more time sensitive deliveries in 1999 than in 1996, while time-sensitivity declined for only 9% of the firms. Indeed, about 55% of the respondent classified over half of their total dispatches as time sensitive in 1999. Many customers now require fast, frequent deliveries.

Second, the survey suggests that that the internet had become a part of the trucking firms' business by early 2000. Among the respondents, 75% report at least minimal internet activity. At the same time, however, the impact is at its very early stages of both investment and customer activity. The firms on average devoted only about 12% of their investment in new technology on internet-related projects. Internet sales activity is even lower, also, as on average the firms with internet activity procure only about 5% of their shipments by the internet in 1999. Thus, although internet applications are diffusing widely among trucking firms, they still account for only small parts of the firms' business activities.

Third, most of the internet applications were developed internally by the trucking firm (78%), sometimes in conjunction with consultants. Our conversations with trucking firm managers suggest that the nature of the trucking industry requires company specific knowledge to develop effective internet applications, at least at this early stage of internet diffusion.

Fourth, the firms report substantial organizational changes since 1996, particularly for firms with the greatest internet activity. The organizational changes include (a) more cross-functional work, (b) increased span of control for dispatchers, (c) addition of line-haul terminals, (d) increased hiring of drivers for local networks and information technology personnel, (e) restructuring of organizational departments, and (f) active alliance and acquisition activity.

(a) Many firms (67%) report that cross-functional work is more common. Such cross-functional work helps achieve the integrated activities of asset-based transportation management.

(b) Dispatchers and other managers at many firms (65%) have greater span of control than they did three years ago. This increased span of control both increases productivity and provides more direct coordination of the complex delivery schedules and activities of asset-based transportation management.

- (c) Many of the firms (34%) increased the number of terminals they operate, although few firms (16%) firms reported significant increase in the length of haul. The increased number of terminals provides denser line-haul networks and allows the firms to provide quicker responses for time-sensitive deliveries.
- (d) Employment changes reflected the changes in time sensitivity and the growth of internet applications. We found the number of full time employees in every category of employment to have increased or stayed the same since 1996 consistent with good economic conditions. Increased employment was most common for line-haul drivers (66% of the firms) and pickup-and-delivery drivers (64% of the firms) in LTL operations, consistent with the finding we report above that firms increased the number of terminals they operate. The need for more fine-grained time-sensitive deliveries has led to greater need for people for these activities. The number of programmers and other information technology most often stayed about the same from 1996-1999 (53% of the firms), although a substantial minority of firms (39%) reported increased IT staff. Moreover, firms that invested in internet technology were almost twice as likely (36% versus 20%) to hire more programmers and systems personnel than firms that did not invest in internet technology). Clearly, firm often need to invest in new information technology personnel in order to develop internet applications.
- (e) Organizational change was common, particularly for firms offering internet services. Many respondents added new departments (48%) and/or eliminated old departments (63%). Firms using internet applications were the most likely to undertake structural change by adding ($r=.14$) or eliminating ($r=.13$) departments. These trends suggest that organizational rationalization is necessary for firms to avoid having a mismatch between the new services that they offer and their old organizational structures.
- (f) Inter-firm activity involving alliances and acquisitions was common. Many firms created new alliances (51%), while a sizable minority acquired other businesses (28%). These inter-firm changes are part of the process of offering integrated transportation management services, whether as “virtual” systems through alliances or integrated systems within single companies. In addition, many firms have ended old alliances (25%) and/or divested parts of their old businesses (22%). Firms with internet applications were somewhat more likely to create new alliances or acquire new businesses ($r=.06$). As in the case of departmental rationalization, these inter-firm rationalization activities are part of the process of changing the mix of services that the firms offer.

Fifth, although it is still far too early to assess the full impact of the internet, four initial observations about how the internet may influence business changes are notable. The observations include (a) overall management of change, (b) exploitation activities, (c) exploration activities, and (d) joint pursuit of exploitation and exploration opportunities.

- (a) Overall, many firms (50%) reported that the internet helped them manage change.
- (b) Firms using the internet found that it had the substantial impact on exploitation opportunities, that is, on building directly on existing activities. Existing activities that commonly benefited include improving internal process quality (56%) and process time (43%); improving

external relationships with shippers (52%), consignees (45%), and third-parties (49%); improving service speed (42%), timeliness (32%), and dependability (34%); reducing costs (33%); improving dedicated services (32%); and analyzing customers (33%). By contrast, the internet had little impact on shipment length or size (5% to 12%).

- (c) At the same time, the internet also contributed to exploration opportunities, including adding new customers (58%), new services (38%), and new markets (34%).
- (d) The comparative results show that exploitation and exploration are complementary activities, rather than substitutes. The firms that reported higher mean exploration usage of the internet also reported higher mean exploitation activities ($r=.69$). That is, firms rarely sought exploration opportunities without also attempting to exploit existing skills in more depth. This joint emphasis reflects the competitiveness of the industry, which leaves little room for future-focused strategies that do not also pay close heed to improving current operations.

The results that we report here serve as an indication of firm-specific actions in response to the emergence of the internet environment in the trucking industry. The results consistently show that competitive conditions are changing and that many firms are seeking both exploitation and exploration opportunities to position themselves to advantage in the turbulent world of e-commerce.

D2. Adoption of web-based EDI and mobile communication

Manufacturers and retailers now aim to appease the e-consumer's ever increasing appetite for information. Consequently, shippers are insisting that carriers provide visibility for the freight from the buy button on a retailer's web site to the customer's door. Knowing where the freight is or where it will be at all times gives an opportunity for shippers to respond to changing market conditions and reduce costs associated with obsolescence and product handling. Trucking companies have responded to this challenge in several ways, including mobile communications, internet-based EDI, and information-based service quantification.

Mobile communications connects trucks with the office, thereby providing substantial transparency throughout the system. Schneider, the nation's largest truckload company was a pioneer in the use of Qualcomm's mobile satellite systems that combine vehicle location with fleet management. The process improvements enabled by the information provided by the system and the extent to which shippers value carriers with "connected" fleets have prompted widespread adoption of three types of mobile communication systems, including (1) cellular communications, (2) specialized mobile radio, and (3) satellite systems. Results from our survey on information technology use in trucking show that these three types of mobile communications systems are now very common among trucking firms. We find that almost two-thirds of the respondents (61%) had adopted at least one, and about a quarter (23%) more than one kind of mobile communication system.

Products that use the internet as the communications vehicle for EDI transactions have dramatically decreased costs. Traditionally, EDI services such as load tendering, status reporting, and invoicing cost thousands and tens of thousands of dollars to set up and run, while also

requiring substantial ongoing effort to maintain inter-firm system compatibility. These costs and difficulties inhibited adoption of EDI systems by small carriers and, in turn, the limited adoption hurt the capability of small carriers to work with large shippers that mandated EDI transactions. Now, some shippers are using systems that allow EDI transactions over an Extranet, which is a secured Internet location that reduces set up costs. Still in its nascent phase, web-based EDI systems require manual entry and have not yet been widely adopted. However, the potential low cost and standardized accessibility of EDI over the internet levels the playing field for carriers that had been excluded from many freight opportunities earlier.

The higher demand for logistics, vehicle and freight tracking, and other information increases the amount of information the trucking firm must process. The data can be used to quantify the quality of service the carrier offers. Details of on time delivery, service records during surge periods, and low damage records provide competitive advantage to trucking firms competing in the new economy. Consequently it is not surprising that we notice this trend in our survey.

As we noted above, our survey results suggest that companies that invest in internet development value the easy acquisition and exchange of information with their shippers, consignees and third parties. Moreover, internet applications may diffuse more widely than traditional dedicated EDI systems have done. Fewer than half the firms in the survey (44%) report using traditional EDI systems, while, as we noted earlier, about 75% of the firms offer internet services. Moreover, about two-thirds (65%) of the firms that do not use traditional EDI have introduced internet services. Early indications, therefore, suggest that more standardized internet applications may prove more widely accepted than traditional EDI systems, which are often dedicated to particular customers.

E. Conclusion

Rich Hardt, director of systems development at Yellow Corporation, said as he announced that Yellow had signed on to be the transportation provider for eChemicals, "One Internet year is seven business years and twenty transportation years." Trucking firms are having to adapt to the "Free, Perfect, Now" e-commerce environment or go out of business.

Many firms in the industry have adapted by making major changes in business practices, involving both exploitation of existing skills and exploration of opportunities that require new capabilities. Trucking firms are participating in the new economy by expanding existing resources, adopting new technologies to enable internet-based communication with their customers, and by improving processes to improve service and efficiency. The freer flow of information, the connectivity, and the opportunity to aggregate dispersed information have spawned new web-enabled businesses and these new entrants are challenging many traditional assumptions and business practices. At the same time, trucking industry incumbents are using alliances and acquisitions to redefine themselves as asset-based transportation management companies. In this process, the industry incumbents have had to modify their existing organizational structures, systems, and people to execute the e-commerce strategies. The industry is facing its greatest challenge since deregulation two decades ago.

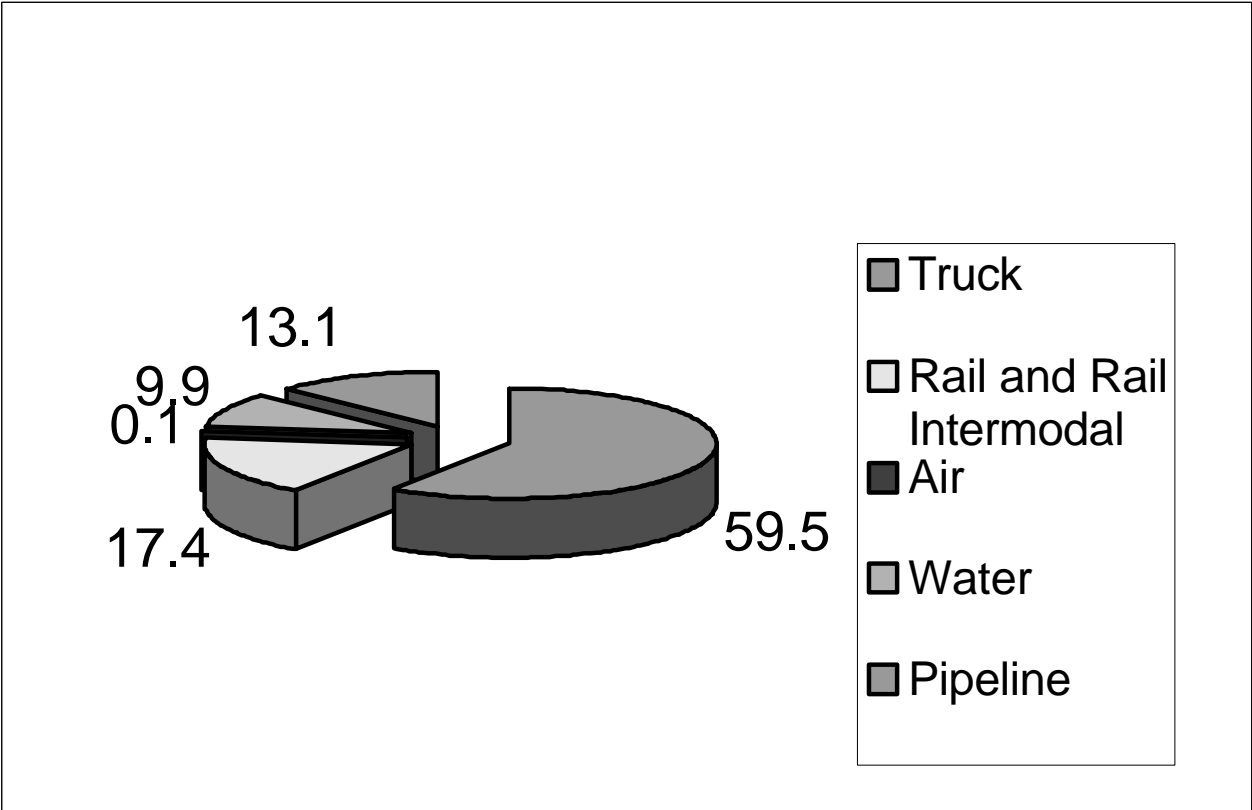
The actions of the trucking firms will affect far more than the performance of the trucking services industry alone. In addition, the response of trucking firms to internet-based opportunities and challenges will have major influences on the economy as a whole. The future of e-commerce depends on how physical goods are transported within the constraints of time, cost, and quality. As a result, the response of established and new trucking firms will play a significant role in determining the extent to which the full potential of e-commerce will be fulfilled in the economy.

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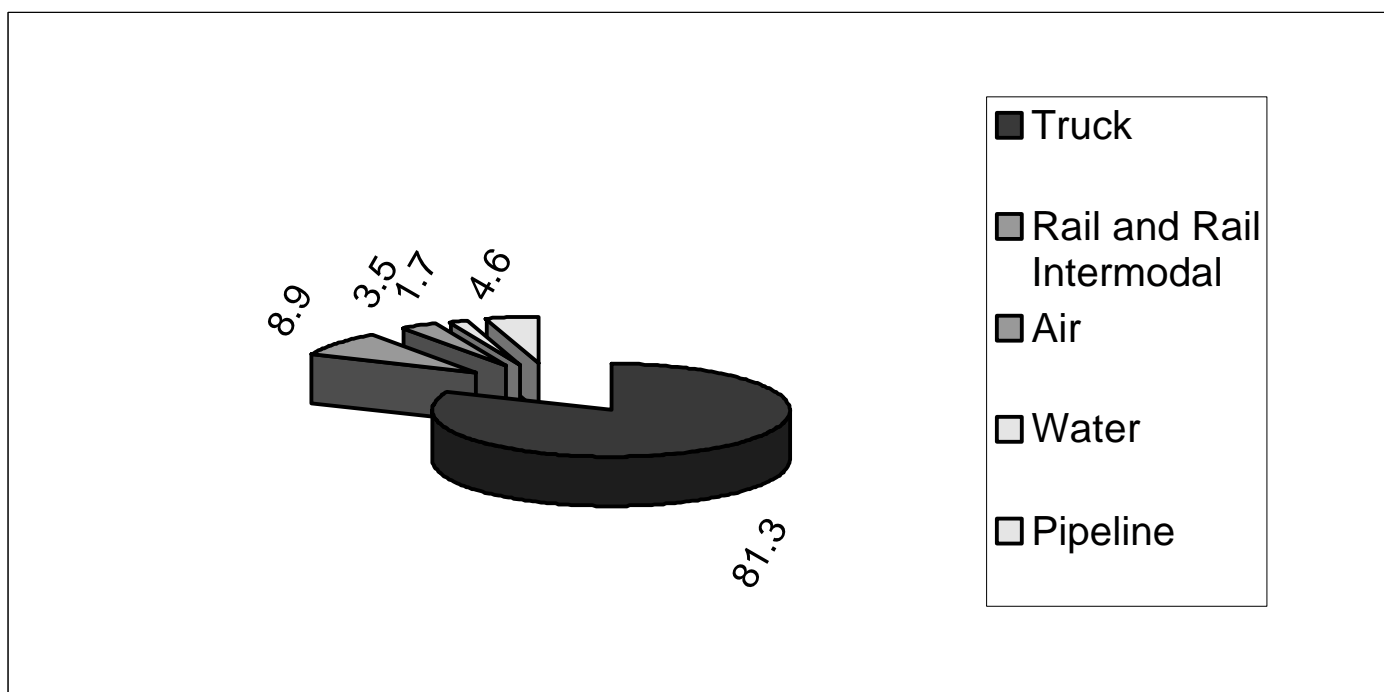
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Figure 1. Primary Freight Volume by Mode (1997)



Source : Commodity Flow Survey, 1997. Washington D. C. U.S Bureau of Census

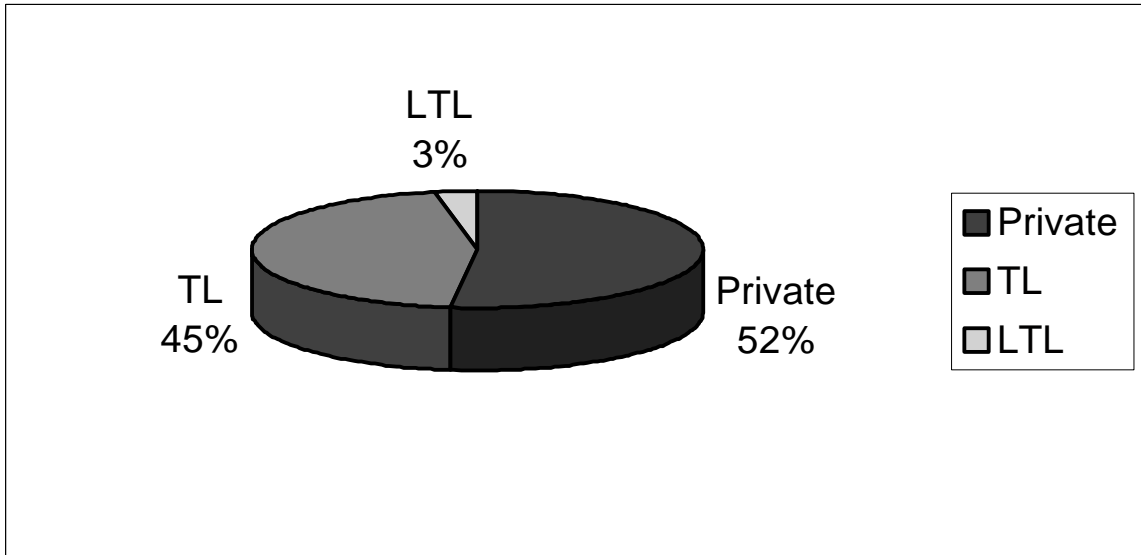
Figure 2. Primary Freight Revenue by Mode (1997)



Source : Commodity Flow Survey, 1997. Washington D. C. U.S Bureau of Census

Figure 3. General Freight Shipment by Carrier Type

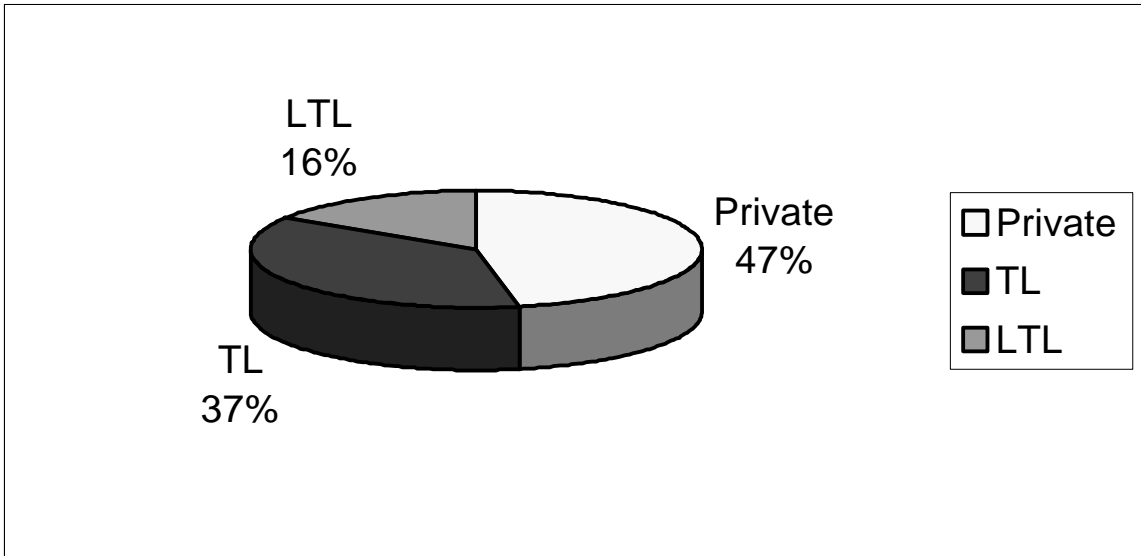
Volume
1997



Source : American Trucking Association

Figure 4 – General Freight Shipment by Carrier Type

Revenue
1997



Source : American Trucking Association

Table 1

Load Matching Exchanges

EFlatbed (specialty)	Carrier \$24.95
Efr8 (TL)	Free trial period
Freightquote (LTL)	Commission
Getloaded (TL <L)	\$35 / month
Internet Freight Terminal (TL)	\$20 / month or \$ 50 / qtr
Loaddock (TL)	\$20
Massmotion (LTL)	\$49
National Transportation Exchange (TL & LTL)	Margin between charge to shippers and payment to carriers
Nettrans (TL) Nettrans Lite (OO)	\$15 / wk or \$49 / mth or \$ 429 / yr
Truckstop (TL <L)	\$35
Tranzlink (TL)	\$14.95
Transportal	Not yet active

